Angina in the Single Coronary Artery

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Introduction

By definition, isolated single coronary artery arises from the aortic trunk by a single coronary ostium and supplies the entire heart regardless of its distribution. This is a rare congenital anomaly and occurs as an isolated finding in approximately 0.024 percent of the population\(^1\). In about 40\% of the reported cases it is associated with other congenital anomalies\(^2\). Diagnosis was first made
in a living patient by angiography by Halperin in 1967\textsuperscript{4}.

It was said that typical angina did not occur with single coronary artery in the absence of coexisting coronary artery or aortic stenosis. The clinical significance of the isolated single coronary artery anomaly depends on the adequacy of its orifice and on whether there is any acute angulation or compromise of the major branches as they traverse the base of the heart passing between or around the great vessels. Angina pectoris has been reported to occur due to hypoplasia, acute angulation of an artery or atherosclerosis of the proximal vessel\textsuperscript{11}. But angina pectoris by a coronary spasm has not been reported by now in a single coronary artery 3).

We recently experienced angina attacks by a coronary spasm in a 26-year-old female in an isolated single coronary artery and report.

**Case Report**

A 26-year-old female visited our hospital on 2nd February in 1990 for evaluation of frequent chest pain, first noted three years previously. She had severe substernal oppression during washing face or brushing teeth in the early morning with several minutes duration with 3-6 frequencies. Angina was relieved by rest or nitroglycerin sublingual.

There was no chest pain during exercise. She had no previous history of hypertension, diabetes mellitus, cigarette smoking. On physical examination, she was a healthy-looking lady. Height was 160.5cm, body weight 51.5kg, lean body mass index 20.1, blood pressure 120/70 and pulse regular at 70/min. Palpation and auscultation of the heart revealed no abnormal physical findings. Chest X-ray showed no abnormal findings (Fig. 1). Serum cholesterol was 176, 163 mg/dl in each (90-240), serum triglyceride was 102, 91 mg/dl in each (30-200), serum high density lipoprotein cholesterol was 66 mg/dl (30-80).

Seum lipoprotein electrophoresis showed normal pattern. An electrocardiography at rest was normal. Echocardiography showed no associated congenital anomaly. She completed 10 Mets of an exercise test (Bruce protocol) and at that time heart rate increased to 150/min from 88/min before treadmill test, but she had 1mm horizontal ST segment depression in lead II, III, aVF and V\textsubscript{6} on a postexercise electrocardiography (EKG) with chest pain (Fig. 2).

At coronary angiography the right coronary artery originated from the mid left anterior descending artery and ran in front of the pulmonary artery-Lipton and Smith classification type LIII\textsubscript{A}. Left coronary angiography revealed about 40\% stenosis of the mid left anterior descending artery and the proximal right coronary artery just branching from left anterior descending artery but she did not complain chest pain and electrocardiography showed no ST-T segment change (Fig. 3). Intracoronary nitroglycerin 200 \mu g injected into the left coronary artery. Repeat left coronary angiography revealed the arteries to be completely normal although 30\% stenosis in the mid right coronary artery was noted (Fig. 4).

A clinical diagnosis of variant angina in the single coronary artery was made and she was maintained on treatment with a combination of isosorbid dinit-
Fig. 2-A, B. A, An electrocardiography at rest was normal. B, She had 1 mm horizontal ST segment depression in lead II, III, aVF and V₆ on a postexercise electrocardiography with chest pain.

Fig. 3-A, B. Type LIIₐ. Right anterior oblique(A) and left anterior oblique cranial projection(B). Left coronary angiography revealed about 40% stenosis of the mid left anterior descending artery and the proximal right coronary artery just branching from left anterior descending artery.
rate and diltiazem. In a recent follow-up, 4 months after medication, she was well and little symptomatic and working full time.

Discussion

Single coronary artery is an uncommon finding with an uncertain prognostic importance. Within the surveyed literature, we located a total of 164 acceptable cases.

Sharbaugh reviewed literature yielded 159 cases and reported 164 cases including his 5 cases by analyzing of the anatomic variation and clinical importance2).

The anatomic classification of a single coronary artery has been done by Smith in 19501, Ogden in 19702, Sharbaugh in 19743 and by Lipton in 19794. The mechanism of formation of the single coronary artery has not been yet clearly clarified and several theories have suggested.

Sharbaugh reported 71 with associated congenital anomalies of total 164 cases. Associated anomalies included transposition of great vessels, tetralogy of Fallot, improper division of truncus arteriosus, additional coronary artery anomalies, fistulae between the coronary artery and the right atrium or ventricle, endocardial fibroelastosis and other anomalies.

According to Smith’s classification 7 cases of type 1, 27 cases of type 2 and 37 cases of type 3 were noted. In case of type 2a pattern associated with tetralogy of Fallot or transposition of the great vessels, inadvertent incision of the anteriorly located branch may occur at heart surgery and he advised to pay attention to that. An association between bicuspid aortic valves and single coronary artery has been proposed. But he considered this association coincidental. Sharbaugh reported 93 without associated congenital anomalies of total 164 cases. According to Smith’s classification 34 cases of type 1, 52 cases of type 2 and 7 cases of type 3 were noted.

The diagnosis is first suspected by failure to enter coronary ostium. The diagnosis is established by aortic root injection demonstration only one coronary ostium, and by angiographic evidence revealing that the entire heart receives its blood supply from the artery present.

But differential diagnosis includes several other conditions - complete obstruction or hypoplasia of
one major coronary artery, a very dominant left system or anomalous origin of one coronary artery.

Prognosis for patients with a single coronary artery varies from excellent\(^2,6,7\) with no decrease in life expectancy to sudden death\(^8,9,10\). A single coronary artery in the absence of other congenital heart disease is said to cause neither cardiac disability nor a decreased life expectancy\(^6,7\). However, displacement of an ostium may cause accelerated atherosclerosis. Congestive heart failure and death from cardiomyopathy have been reported\(^11\).

Single coronary artery may contribute to angina because a relatively small proximal vessel may either become diseased or may make distal coronary arterial lesions more hemodynamically significant by reducing coronary blood flow\(^12\).

Patients have been reported in whom sudden death was associated with a major coronary artery coursing between the aorta and main pulmonary artery by mechanism of constriction of the coronary artery by the great vessels or kinking near the origin of such anomalous vessels\(^12,13\).

Sharbaugh reported that 15 percent of patients with single coronary artery as an isolated anomaly develop severe cardiac problems before age 40\(^2\). Angina pectoris has reported to occur due to hypoplasia, acute angulation of an artery or atherosclerosis of the proximal vessel\(^11\). Angina may occur due to coronary artery spasm but no definite evidence has not been reported\(^3\).

This patient continued to experience similar chest pains only in the early morning that had no relation to exertion, meals or posture. She was 26 years old which was very young age to have a coronary artery disease. And she had no previous history of hypertension, cigarette smoking, diabetes mellitus or hyperlipidemia. Chest pain always relieved with nitroglycerin and so she used nitroglycerin several times in the early morning.

Yasue reported that hyperventilation could induce a coronary artery spasm and angina pectoris\(^14,15\).

We think that 1mm horizontal ST segment depression on a postexercise EKG with chest pain could be explained by a hyperventilation induced coronary artery spasm. In addition to above evidences, she was well and little symptomatic in a recent follow-up, 4 months after medication with isosorbide nitrate and diltiazem.

In consideration with these evidences, we can conclude that her chest pains were caused by coronary artery spasm.

Conclusions

Coronary artery spasm can play an important role in the pathogenesis of an angina pectoris in a patient with an isolated single coronary artery.

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References

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